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ROCKS and MINERALS

A Magazine for Mineralogist, Geologist and Collector . . . .

. . . . . Official Journal of The Rocks and Minerals Association

..FEBRUARY, 1937..

Vol. 12. No. 2 FIFTEEN CENTS Whole No. 67

CHIPS FROM THE QUARRY

(Formerly the Bulletin Board)

Special Rock Crystal Number

In this issue we are presenting a series of articles on rock crystal, one of our most popular minerals. We have tried to present the mineral from various angles and trust our efforts have not been in vain.

Taken for a Ride!

Dear Editor:

Complaints have reached me from collectors that my article, "Chester, Vermont, Land of Pyrite Cubes," which appeared in the July 1936 issue of Rocks and Minerals, was very misleading. These and other collectors have made special trips to the locality and failed to find the pyrites described.

That is not at all surprising to me now, as on personal investigation I have found that within three weeks after the article appeared, a number of individuals had visited the locality, with trucks, and hauled the material away. It is too bad that some of our fine minerals have to be taken for a ride in this manner. R. Emmet Doherty, Pres. R. & M. Assoc.

Directors Wanted.

This year, in planning for the Annual Outing, Rocks and Minerals Association will revert to its former program and have state outings under state directors. The outing will be held Sunday, May 23rd (tentative date).

The Editor would like very much to have collectors in various sections of the country volunteer as state directors for their respective states. Will those who are interested please send in their names to the Editor, Rocks and Minerals, Peekskill, N. Y.?

A Fine Exhibit.

An exhibit of some very choice minerals was held from December 28 through New Year's Day on the 30th floor of 1 E. 44th Street, New York City, by Arthur Montgomery.

The display included groups of magnificent crystals and crystal aggregates of azurite, malachite pesudo after azurite, smithsonite, cerussite and anglesite from Tsumeb, S. W. Africa; very fine polished variscite from Fairfield, Utah; excellent topaz crystals from Thomas Range, Utah; and many other attractive or interesting specimens including a magnificent suite of Copper Mountain, Alaska, epidotes.

Mr. Montgomery is a noted collector and traveler. This past summer he spent at Copper Mountain, near Sulzer, Alaska, collecting the above epidotes. We hope he may be induced to prepare an article on his Alaskan trip for **Rocks and Minerals.** Our readers may recall his very interesting articles "Digging for Opals in Virgin Valley, Nevada" (October 1934) and "Minerals of the Thomas Range, Utah" (November, 1935).

Acknowledgement

We wish to acknowledge our indebtedness to Ward's Natural Science Establishment, Inc., Rochester, N. Y., for four illustrations which appear in this issue These very fine illustrations add much to the magazine and to the interest of the articles printed. Will the Establishment please accept our appreciative thanks?

Resignation of Mr. Schmeltz.

It is with regret we announce the resignation of Mr. Fred W. Schmeltz as Director of Outings. Mr Schmeltz, whose business has kept him in Phoenix, Arizona, for the past two years (his home is in New York City) feels he is so far away from New York headquarters he cannot now serve the Association to the best of his ability.

ROCKS and MINERALS

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Edited and Published by PETER ZODAC

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QUARTZ VAR. ROCK CRYSTAL
(Terminated)
(Enclosing Actinolite)
JAPAN

ROCKS and MINERALS

PUBLISHED MONTHLY

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VOL. 12, No 2

The Official Journal ROCKS and MINERALS of the ASSOCIATION

WHOLE No. 67

ROCK CRYSTALS—SOME FACTS AND USES

(An unusual experience in using the sun as the prospector)

By PETER ZODAC, Editor

Rocks and Minerals

Perhaps no mineral is more widely known and esteemed than is rock crystal. Common all over the world, occurring in most exquisite forms, often absolutely clear and flawless with the brilliant faceting of a precious stone, plus its hardness and almost undamageable nature and low cost, rock crystal is to be found in every mineral collection.

Rock crystal received its name from the early Greeks who called it **Krystallos,** meaning clear ice, as they thought it was water congealed so hard by long and intense cold that it would not melt. They also thought it was procurable only in the frozen regions.

Rock crystal is also known as **limpid quartz** when it is so clear as to resemble water in color; also known as **diamond** when in addition to being limpid it has also the brilliant faceting of a precious stone. Limpid quartz may vary in size from tiny to those of good size; diamond quartz universally is of small size.

In the Middle Ages when many beliefs and superstitions were in vogue, it was believed that rock crystal and poisons could not exist together; hence many cups were made of rock crystal. If a poison was poured into such a cup, the quartz would crack, break or otherwise show the presence of the poison.

In India, the natives believe rock crystal is the mother or external husk of the real diamond; therefore the real gem was called the ripe diamond while rock crystal was called the unripe diamond.

Rock crystal has been and still is used for a wide variety of purposes such as cups, vases, bottles, dishes, ornaments, beads, as gems for rings, pins and other articles of jewelry. It is also used for special glasses, sometimes being fused and wrought into various objects of which the quartz tube in a cold-quartz ultraviolet lamp is an example. Selected pieces of rock crystal, termed optical quartz, are used in high grade optical instruments for scientific and military use; for spectacles, crystal balls, and a number of other purposes. In Japan, rock crystal is cut into large round balls which are said to be used for cooling the hands.

In North America, the two most famous localities for rock crystals are near Hot Springs, Arkansas, and Middleville, Herkimer Co., New York; in South America the provinces of Minas Geraes, Sao Paulo and Goyaz, Brazil are the world's greatest localities for optical quartz; in Europe, Dauphine, France, and the Alps of Switzerland are the most famous; in Africa, the island of Madagascar produces enormous rock crystals; and in Asia, Japan furnishes the best crystals. The finest twin crystals in the world are also found in Japan.

HERKIMER COUNTY QUARTZ CRYSTALS

By D. H. NEWLAND, State Geologist

Albany, N. Y.

Many places in Herkimer County, N. Y., supply or have supplied in the past great quantities of clear, doubly terminated quartz crystals, so brilliant, limpid and distinctive in form as to have won a claim to the attention of every mineral collector. It is probable that Herkimer County is as widely represented among our collections, public and private, as any other American sources of this mineral. There are stores of Little Falls or Middleville "diamonds," so-called, in our museums that have been accumulated over a period of years, amounting in some instances to many hundred examples.

It is not known just where and when the first discovery in Herkimer County was made. Quite likely the pioneer settlers in the Mohawk valley, early in the 18th century, were familiar with the occurrences, for loose crystals were found in the soil where this overlay directly the Little Falls or Calciferous strata. Lewis C. Beck in his Mineralogy of New York (1842), attributes to Professor J. Hadley of Geneva Medical College the credit for first bringing to public attention the abundant occurrence of quartz in Herkimer County. Dr. Beck devotes two or three pages of his classical work to a description of the localities and to drawings of typical forms. Inasmuch as the particulars of occurrence given in that volume hold good even today, and the volume is no longer accessible to many, having been out of print for a long time, we quote the following paragraphs from it

"Uncommonly beautiful specimens of rock crystal, perfectly transparent, have been found in various parts of this county ,especially at Middleville, Fairfield, Little Falls, Salisbury and Newport. They are found sometimes in cavities in the calciferous sandstone, and at others, they lie loosely in the sand, probably produced by the disintegration of the rock. Mr. Vanuxem has remarked, that there is probably no locality in the world which produces more perfect or more beautiful quartz crystals than Middleville; and with an equal refractive power, they would rival the diamond. They are found of various sizes, and variously grouped. Perfect crystals have seldom been found here of more than two or three inches in length, while those of from three quarters of an inch to an inch are very abundant. They frequently contain specks and small masses of a black substance, which is believed to be anthracite. Its behaviour before the blowpipe agrees entirely with that mineral. Sometimes these crystals have cavities, which are partly filled with some fluid. When these have been shivered by the cold, the cavities persent a yellow resinous appearance, from which it may be inferred that the liquid is bituminous. From the number of fragments which present this appearance, it is probable that the crystals containing this liquid were originally very abundant.

"At Little Falls, the quartz crystals are usually contained in cavities in the calciferous sandstone, and it is not uncommon to find them imbedded in the powder of the anthracite.

"The crystals from Salisbury are larger than those from any other locality in the county, but they have seldom been obtained so perfect as at Middleville. Here also large masses of anthracite were found associated with the quartz. The crystals from this locality are sometimes from four to six inches in length.

"At all the above localities, twin crystals, and groups of crystals variously united, have been found. Middleville, however, is the most remarkable in this respect. Crystals of quartz, usually small, are also often found lining the walls of the cavities which contain the loose crystals."

The occurrence of the crystals coincides more or less with the outcrop of the Little Falls dolomite which is exposed at that place in horizontal beds nearly 450 feet thick. This formation in many places lies directly upon the Precambrian rocks of the Adirondack area, but may have thin layers of Potsdam sandstone intervening between its base and the older crystallines. There are more or less continuous exposures to the north or south of the river east from Little Falls as far as Amsterdam, Montgomery County, and north into Saratoga and Warren counties. Where the beds are not seen it is likely to be the result of faulting, which has displaced them locally several hundred feet. The faults have a northeasterly trend with the downthrown side to the east.

The Little Falls dolomite originally may have been a limestone, with calcium carbonate as the main ingredient. By later substitution of magnesium carbonate for part of the calcium there resulted the present dolomitic rock with considerable shrinkage in volume, which shrinkage is responsible for the cavities and seams commonly present. These cavities are often lined by chalcedony. The quartz crystals are found lying loose in them, less frequently attached to the walls, and may number anywhere from one to a dozen or more, in a single opening. In size they range from minute individuals that require the aid of a hand lens to discern their forms to two or three inches diameter. Usually the small crystals excel in perfection and brilliancy.

A common but not invariable associate is amorphous carbon, brilliant black with splintery or conchoidal fracture, called coal or asphalt by the early mineralogists. The carbon occurs as inclusions within the quartz, also in separate masses that may completely fill the cavities. Undoubtedly it is an earlier deposit, resulting from infiltration of petroleum or some bituminous compound that has gradually been distilled until only carbon is left. A film of silica may be spread over its surface. It is non-combustile under the gas flame, and consequently cannot be classed with the coals. It likewise differs from graphite in its superior hardness, brittleness and in having a considerable content of water.

Calcite and dolomite are occasionally found in the cavities. They present no unusual features.

Almost any quarry in the Mohawk Valley which uses the Little Falls dolomite can be counted as a possible source of the crystals. St. Johnsville, Sprakers, Canajoharie and Amsterdam may be named in addition to the Herkimer County localities as sources of supply. Some of the quarries around Saratoga Springs also carry crystals. Well known in the early days were Diamond Point and Diamond Island on Lake George which derive their names from the occurrence of quartz, likewise found in dolomite.

To those who wish to collect first hand it is recommended that they concentrate their attention on some quarry under operation or recently operated and search along the face and floor of the quarry, also if they have opportunity look over the blocks of stone as they are blasted out. A quicker method is to enlist the services of some quarryman who is mineral-minded. Usually one will find a workman who has accumulated a store of the crystals and then it becomes a matter of mutual arrangement between buyer and seller. The supply, apparently, will last for years to come.

Praktikum der Edelsteinkunde

By George O. Wild

Author, lecturer, traveler, gem expert, and a frequent contributor to the pages of Rocks and Minerals, Mr. Wild's new book "Praktikum der Edelsteinkunde" will be widely acclaimed by German-reading collectors and mineralogists. The book, which has just been released, consists of 140 pages, 3 colored plates and many black and white illustrations. Published by Francksh'sche Verlagshandlung, W. Keller & Co., Pfizerstrasse 5-7, Stuttgart-O, Germany. Price RM 6.00 ($2.40) for standard publication and RM 8.60 ($3.44) for linen bound copy.

We hope to have an English review of the books in a future issue.

HOW TO TELL RIGHT-HANDED AND LEFT-HANDED QUARTZ CRYSTALS

By MAURICE R. THOMPSON

Some quartz crystals show small faces on the corners near the termination. These are known as plagiohedral (obliquely or spirally arranged) faces, but are more commonly called the extra, supplementary or rare planes. A study of them may enable one to classify the crystals as being either right-handed or left-handed individuals and thus enhance their meaning and value. Information on this subject has previously been scattered, fragmentary and probably little understood by the average mineral collector.

The writer's special interest in these rare planes was aroused in 1929 by Mr. John A. Grenzig, on the occasion of the first of a memorable series of visits to the Brooklyn store. Two similar quartz crystals were produced and extra planes on each were carefully pointed out. Fascinated by the novelty, a decision was made at once to take one of these prizes, but the selection of the better one became a dilemma. Finally, Mr. Grenzig furnished the solution by suggesting that both be taken, in view of the reasonable price, which was done without subsequent regret.

The "quartz" which we intend to discuss is alpha-quartz, or low temperature quartz and has crystallized below 573 degrees Centigrade. Such quartz is enantiomorphous, or "opposite-formed," meaning that every simple crystal is either a right-handed or left-handed individual The two kinds of crystals may show external differences in faces and form "mirror-images" of each other. They are always different internally in atomic structure. Apparently, Hauy made the early discovery that quartz crystals could be sorted into opposite kinds if certain plagiohedral faces were evident. In 1811, Arago discovered that quartz plates would rotate the plane of plane-polarized light passing through them in the direction of the crystal axis. Shortly after, Biot made a number of important observations on this optical effect. Finally, Herschel (1) in 1820 rounded out the subject by showing quite conclusively the definite relation between Hauy's crystal faces and the optical effect of Arago and Biot.

In modern practice, a thick basal section of a crystal is placed under the petrographic microscope and found, if right-handed (dextrogyrate), to rotate the plane of polarized light to the right, while if left-handed (levogyrate) the rotation is to the left. This action is called circular or rotary polarization. Such quartz plates are used for the analysis of sugar solutions in an optical instrument known as a polarimeter. It is said that crystals used for this purpose are examined for extra planes as an aid in classifying them previous to cutting.

Herschel's work was based on a study of the polarization produced by plates cut from 23 quartz crystals. The first 14 of these are stated to have included 7 right-handed and 7 left-handed specimens. Each of the crystals examined was selected on account of showing definite plagiohedral faces and apparently these were always X-planes. Herschel compared the position of his index plane with the direction of polarization and found exact agreement in every case. In other words, he could predict accurately the optical effect from an inspection of crystal form. This established the fundamental importance of rare planes.

There are other methods of distinguishing the two kinds of crystals. Thus, each develops a different etching pattern on treatment with a suitable chemical like hydrofluoric acid. Pyroelectric tests will also give an indication.

All these methods will afford a positive identification, but they require either injuring the specimen or else facilities and technique not possessed by the average collector.

It may be of considerable interest to digress slightly and inquire whether quartz is unique among minerals by being enantiomorphous. On this point, Johannsen (2) says "The only other natural mineral known to possess the property of rotary polarization is cinnabar." Cinnabar crystallizes in the same class as quartz and also shows right-and left-handed forms. Incidentally, it has considerably more polarizing power.

Beyond this point, considerable contradiction and uncertainty appear to exist and the subject becomes befogged. Cuprite is always listed in the plagiohedral class of the isometric system, as its crystals sometimes show very distinct plagiohedral faces, although otherwise they are normal. Thus Miers (3) says "The (cuprite) crystals do not rotate the plane of polarization of plane-polarized light." The evidence is even less certain with a few other isometric minerals. Walker (4) states "It is probable also that the minerals halite, sylvite sal-ammoniac and cerargyrite belong to this class of the isometric system with cuprite." The rarity of rotary polarization among minerals is curious in comparison with its frequency among organic substances We may conclude that quartz is the only common mineral showing right-and left-handed crystals Fortunately, these are relatively large and easy to inspect. The amateur, therefore, is practically limited to quartz when studying this property of minerals

In addition to individuals, the parts of contact-twins can sometimes be classified. The rare penetration-twins may be considered as a mixture of two individuals. Such twins may be a combination of either two right-handed or two left-handed individuals (Swiss or Dauphiny law), or of a right-and a left-handed individual (Brazil law). Extra planes if present also serve to distinguish penetration-twins, but this subject is too advanced for present consideration.

Obviously, there will be no visual difference in the appearance of the two kinds of crystals if, as is most frequently the case, there are no extra terminal planes present. The average collector would then have no particular interest in classifying them, even if it were easy to do so. Let us suppose, however, that a few crystals have been sorted out which show good extra terminal planes. Some of these crystals can certainly be classified into "rights" and "lefts" and this will prove to be a fascinating problem for the patient observer.

So far, we have not stated definitely just how crystals are classified by means of the position of extra planes. Before coming to the point, it will be desirable to introduce for the benefit of some readers a brief description of quartz crystals in general and a definitions of the symbols to be used. It will be necessary for this purpose to indulge in a few large words and to assume on the reader's part a limited knowledge of plane and solid geometry. On the other hand, it will not be essential for the reader to fully understand or memorize this section at the first attempt. A little practice in the actual comparison of crystals with the figures of the diagram will tend to make the process of identification instinctive, just as we do not have to stop to think which hand is right or left. The explanatory text can then be used for convenient reference and study when needed.

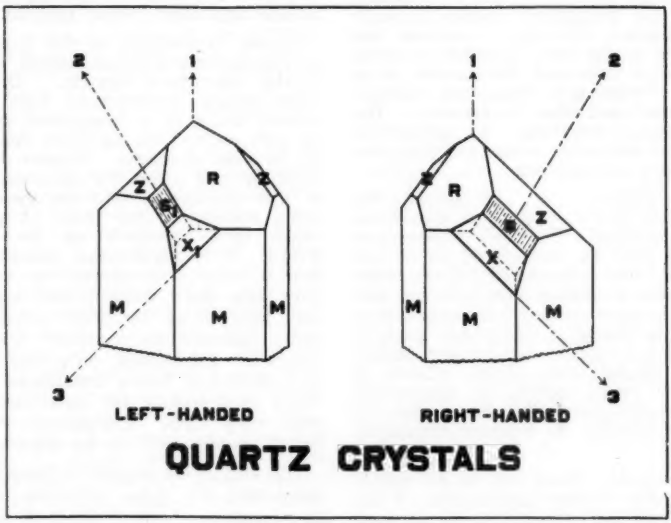
Quartz crystallizes in the trigonal-or rhombohedral-trapezohedral class of the hexagonal system. In the most typical symmetrical form, the crystal body is a hexagonal prism M, with each of the six faces denoted by M (See diagram). Capital letter symbols are used for convenience in this discussion and on the diagram instead of the more common small letter symbols of the textbooks. It is understood throughout that a crystal is viewed as if the long axis were vertical and with a side face M of the body prism directly opposite the observer. Unless otherwise mentioned, only one end of a crystal is being considered. A hand lens should be used except with very large specimens. Distorted crystals will not be discussed.

The end of the crystal is capped or terminated by three alternate faces of a positive rhombohedron R, each of these being denoted by R, and by three alternate faces of a negative rhombohedron Z, each of these faces

being denoted by Z When equally developed, these combined six faces suggest the presence of a hexagonal pyramid, but this is only a sort of coincidence. The R-rhombohedron is the dominant one and sometimes shows larger and brighter faces than the Z-rhombohedron, but this difference is not always evident and is, therefore, not very reliable for regular purposes of identification.

The corners of a crystal where all of these faces, M, R and Z, meet below the point or apex, are occasionally flattened or truncated by additional small faces. The most common of these are caused by the presence of a right or left trigonal pyramid S, and are known as S-planes. (These planes were formerly denoted by some authors as 2/2, 2P2. 2P2/2 or 2P2/4 and may be so found marked on old labels). At the maximum, these S-planes appear on three alternate corners but the most common condition is to find one good plane on say the first corner, a second faint plane, perhaps not much more than a line, on the third corner and none at all on the fifth corner. The S-plane always has the shape of a parallelogram and is sometimes called the "rhomb-face."

Still less common and usually less well-developed is a right or left plus trigonal trapezohedron X, which can produce three X-planes on alternate terminal corners. (These planes were formerly denoted by some authors as 6-5/6, 6P5/6 or 6-6/5, etc., as 6-5/6, 6P5/6 or 6-6/5, etc., and may be so found marked on old labels). Either the S- or the X-planes may be present alone, or they may be present together. In the latter case, they are located in pairs on the same corners, with the X-plane just below the S-plane. When alone, the X-plane can apparently have a triangular shape, but otherwise or when with the S-plane it has the shape of a trapezoid. It cuts the prism at a much flatter angle than the S-plane. The diagram shows figures of crystals with both an S- and an X-plane and the dashed lines indicate the continuation or portion of the former which is cut off by the latter, but the striations on the continuation of the



S-plane, which will be considered shortly, are omitted to prevent possible confusion. Doubly terminated crystals having S- and X-planes may show these planes at both ends and will then appear the same when turned through 180 degrees, or end for end. The actual size of a crystal seems to be no necessary criterion of the presence of rare planes. They may be quite prominent on tiny crystals, for instance, and entirely absent on huge ones. If present on large crystals they are, of course, likely to be correspondingly large.

Some distinction is usually made between the symbols for the right and left pyramids and trapezohedrons. This has been indicated on the diagram by using S, S subscript 1, X and X subscript 1.

Summing up, we are now fairly familiar with the pyramid S, which produces S-planes, and the trapezohedron X, which produces X-planes. Many much rarer forms are also possible, but need not be considered here.

This completes the more technical aspect of our subject and the rest is easier. We are now in a position to discuss simple methods for applying this knowledge to the identification of actual crystals. Various authorities have presented rules for this purpose. For instance, Miers (3) gives quite a complete set as follows: "The two varieties—may be distinguished in three ways: (1) by the position of the X-face, which in a right-handed crystal lies below the right-hand corner of R; (2) by the direction of the zone MXSZ, which in a right-handed crystal follows the direction of the thread of a right-handed screw at both ends of the crystal; and (3) by the direction of the striae on S, which are parallel to the edge SR, and therefore follow the direction of the zone MXSZ. By means of these striae it is easy to determine the right- or left-handed character of any crystal on which S exists, even when X is absent and when R and Z cannot otherwise be distinguished." The corresponding rules for a left-handed crystal are obvious. The third rule serves to locate R and Z. Striations on S, parallel to the edge SR, point toward Z and knowing Z then R can be found. On a right-handed crystal S is, of course, to the right of R and vice versa for a left-handed one.

Striae or striations (lines, ridges or grooves) on S-planes are not often shown in illustrations, but examples are given by Egleston (5), Niggli (6), and by Miers (3). Apparently, these striations are caused by an oscillation or contest between S and R or M They do not necessarily point the long way of the S-plane and to emphasize this point the two figures of the diagram have been made different. Bayley (7) says that S-planes "are always striated", which would be highly desirable, but the writer has been unable to confirm this in many cases even by using a high power microscope.

Even with such excellent rules as the above available, the whole matter always remained obscure to the writer. During seven years of casual interest, not one single crystal in the collection has been identified satisfactorily. Evidently, a simpler rule was needed, one which would require less knowledge of crystallography, shorten the jumble of lettered planes and flash attention on some vital point. Recently, the solution of this puzzle seemed to arrive with the thought that a rule could be framed in two parts as follows and be very easy both to remember and to apply:

Rule for Quartz Crystals.

Striations on an S-plane point in the upward direction to the right of the apex on a right-handed crystal and to the left of the apex on a left-handed crystal. The lower long edge of an X-plane points in the downward direction to the right of the apex on a right-handed crystal and to the left of the apex on a left-handed crystal.

This arrangement will be quite evident by comparing lines 2 and 1 for the S-plane and lines 3 and 1 for the X-plane on the proper figure of the diagram. The rule only mentions the rare planes and presupposes that they have been recognized at a glance. The natural lines of the crystal make the basis of reference.

After this time, the subject seemed to become "as clear as crystal" and

knowledge of the new form of the old rule became almost instinctive. All the specimens on hand were soon classified and likewise new ones whenever obtained, as far as this would be possible. To illustrate what can be expected, the results on all quartz crystals with well-defined S- or X- planes in the writer's collection are tabulated below:

SUMMARY OF RESULTS ON 50 PLAGIOHEDRAL QUARTZ CRYSTALS

Locality	Number of Right-handed Crystals	Number of Left-handed Crystals	Number of Indefinite Crystals
1. Herkimer County, N. Y. 1 /.....	17	4	9
2. Near Hot Springs, Ark. 1 /.....	2	3	3
3. Blue Mountain, Ark. 1 /.....		2	
4. Province of Goyaz, Brazil. 1 /.....	1	1	
5. Near Florissant, Colo. (Smoky) 2 /.....			1
6. St. Gothard, Switzerland. (Smoky) 3 /....		1	
7. Grant County, New Mexico. (Citrine) 4 /	1		
8. Province of Kai, Japan. (Japan twin) 5 /	2		
9. Dauphiny, France. (Smoky) 6 /.....	1	2	
Total.....	24	13	13

Crystals: right-handed	48%
" left-handed	26%
" indefinite	26%
	100%

1 / Only S-planes present.

2 / Both S- and X-planes present.

3 / Only X-planes present.

4 / Both S- and X-planes present; identified by X-plane only.

5 / Both S- and X-planes present on each twin.

6 / One left-handed crystal has X-plane only. The others have both S- and X-planes.

In addition to the above, there is also a smoky crystal from Pike's Peak, Colorado, which appears to be a penetration-twin of two right-handed individuals (Swiss or Dauphiny law), and a clear crystal from Province of Goyaz, Brazil, which may possibly be a penetration twin of a right-handed and a left-handed individual (Brazil law).

It will be noted that a majority of the crystals were definitely identified, also, that among those identified the right-handed individuals were considerably more numerous, just as happens to be the case with humans. Presumably, if data on a large enough number were available, the distribution among crystals would be found to be approximately equal. Miers (3) says in this connection: "The two varieties are about equally common." It would be interesting, however, to have this point checked through reports from a large number of persons having crystals from widely-scattered localities. If any other observations are warranted, the writer has a feeling that S-planes on crystals from Herkimer County, New York, may be more common than for other localities, also, that X-planes favor smoky crystals.

In conclusion, the writer hopes that many collectors will find interest and amusement, without too much eye-strain and headache, in classifying their quartz crystals by the aid of the above rule, or any other one more suited to the purpose.

Some difficulty was found in obtaining enough satisfactory study material for the preparation of this paper. Grateful acknowledgment for their cooperation is due to the following: Mr. H. T. Daniels, Dardanelle, Ark.; The Gem Shop (Mr. A. J. Harstad), Helena, Mont.; and Mr. W. J. Hollister, Little Falls, N. Y.

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INCLUSIONS ROCK CRYSTAL

By PETER ZODAC, Editor
Rocks and Minerals

Inclusions in a rock crystal are usually foreign particles which have been enclosed or imprisoned in the crystal while it was crystallizing out from a liquid solution. Inclusions vary in number, size, color and form. They may occur as tiny crystals, or grains, as slender threads, as sands, liquids, or even gases; or they may be sufficiently massive to be a more or less prominent feature of the containing crystal. When small in size or quantity they show themselves to be what they are—stray minerals that were caught trespassing in a locality claimed, in this instance, by some silicon dioxide. But the included mineral can be of such importance, or so large as to occupy a considerable portion of the crystal, conforming to the crystal's shape, as in certain carbon inclusions, or completely dominating the crystal, as black tourmaline often does, making the crystal opaque, even robbing it at times of its outer luster.

Occasionally the inclusion is not another mineral, but a quartz crystal —quartz within a quartz. This has no reference to phantom crystals, which are evidences or processes of growth, but to actual, independent quartz crystals, surrounded by the same substance, through which the imbedded crystals are clearly seen.

Inclusions do not follow any law as to arrangement or size. They may lie scattered in all conceivable positions; segregated heavily in one spot while elsewhere they are absent; they may be entirely enclosed in a crystal or they may often project from it and even encrust the crystal; or they may form one large crystal or mass with the quartz as a shell around it. In fact they are quite lawless in the way they take possession.

With many collectors, inclusions, whether they be in calcite, fluorite or other minerals than the rock crystal we are considering here, are eagerly sought and carefully noted, and the writer would recommend the reader to look over his own specimens for these interesting occurrences. Some of the inclusions will be found to be quite beautiful; all may bring up the questions as to how and why they happened. Some will be of a mineral softer than the rock crystal surrounding them, such, for instance, as molybdenite; we can expect others to be as hard or harder.

Inclusions are so many and varied that this article can not be an exhaustive list of them all Rather it is intended to arouse your interest. Therefore, the writer is listing only such inclusions as have actually been noted by him, with a few occurrences reported by others. It has been observed by the writer that when rock crystal or any other transparent crystal occurs imbedded in thick masses of chlorite, epidote, tourmaline or other minerals, be they in crystals or other form, these minerals are often inclosed by the transparent crystals.

Some of the many inclusions observed in rock crystal are:

Actinolite—In acicular green crystals (needle-like, hair-like or thread-like crystals). Excellent terminated crystals with green needles of actinolite shooting through all parts of it have been found in Japan, Switzerland and Cornwall, England.

Albite—Tiny inclusions of white crystals in quartz occur near Hot Springs, Arkansas.

Amethyst—At Cripple Creek, Colo., rock crystals often 6 inches long, show large splendid phantoms of amethyst.

Anhydrite—A very fine specimen from Rienthal, Switzerland, 4x4 inches in size, consisting of a group of six rock crystals, all of different sizes and lying in various positions, encloses needle-shaped, almost colorless, anhydrite crystals. The main rock crystal is 4 inches long and 2½ inches in diameter and encloses two anhydrites of which one anhydrite is 2 inches long and extends diagonally from

the base, starting in the rock crystal near the base and piercing the edge of one face. The second anhydrite crystal is 1½ inches long and extends almost vertically within the rock crystal, starting from the base. From one to two anhydrite crystals are in each of the other rock crystals. Some grayish-green chlorite is present in the base of the rock crystals but none penetrates them. Specimen is in the collection of Mr. H. Alban Anderson of Peekskill, N. Y.

Anthracite—Many of the Herkimer County quartz crystals enclose a dense black carbonaceous mineral, commonly called anthracite but whose true identity is not known. It may turn out to be the very compact variety of carbon known as schungite. This anthracite is frequently immersed in a liquid inclusion and moves in the liquid.

Asbestus—Occurs as capillary (hair-like) whitish crystals, found in Alexander County, N. C., and Cornwall, England.

Aventurine Quartz—Has a shimmer due to spangles of mica or hematite enclosed.

Byssolite—Is present as long, grayish-green hair-like needles in rock crystals that are found in Japan; also in short needles in quartzoids from Calumet, Colo.

Bubbles—These are commonly assumed to be air bubbles though they possibly may be gas. They are colorless and are especially noticeable if a liquid inclusion is also present; a bubble will be seen riding atop the liquid as the specimen is rotated slowly from side to side. Some individuals, not very familiar with inclusions, believe movable bubbles to be great rarities and specimens possessing them of high value. Movable bubbles are fairly common and specimens possessing them are worth only a few more cents than their ordinary value. The Herkimer County crystals of New York frequently contain movable bubbles.

In the South Mountains, Burke County, N. C., quartz crystals occur with bubbles which move nearly 2 inches.

Carbon—Same as anthracite.

Cavities—Small irregular shaped cavities, often filled with liquids, gases or both, may be present in a rock crystal. If the cavities have the exact form of the crystal itself, they are known as "negative crystals."

Chlorite—Chlorites are often present in rock crystals as greenish, mossy masses and oftentimes in such large amounts as to almost obliterate the glassy texture of the crystal; it may even coat the crystal. Sometimes chlorite is present as a thin border on the inside of a rock crystal; such a specimen is known as a chloritic phantom crystal. Near Hot Springs, Arkansas; Organ Mountains of New Mexico; Soudan, Minn., and Switzerland, are localities for good specimens.

Clay—This is of common occurrence only when a crystal is cavernous; that is containing slit-like pits extending from the surface into its interior. If crystals occur in clay, the clay will be found to have penetrated them through the slits and will show through. Many fine cavernous crystals with clay inclusions occur in Lincoln County, N. C.

Copper—At an old copper mine in lower Mecklenburg County, N. C., a very interesting association is found — native copper in quartz crystals.

Dolomite—Nice rock crystals, inclosing tiny whitish crystals of dolomite, occur at Placerville, Calif.

Tiny dolomite crystals inclosed in quartz are sometimes found at Middleville, N. Y. Small grayish crystals in rock crystals have been found in the hematite mines of Soudan, Minn.

Epidote—At the copper mines of Copper Mountain, Sulzer, Alaska, beautiful crystallized dark green epidote is very common; rock crystals generally are associated with it. Sometimes needle-like crystals of epidote are found inclosed in a rock crystal. As a rule the rock crystals of Copper Mopntain are very small and slender.

Rock crystals found in Switzerland are known to contain epidote as inclusions.

Gas—See bubbles.

Goethite—Often occurs as brilliant deep red needle-like crystals, called Cupid's darts. Another

name for specimens is Onegite, named after Onega, Russia, where it was first found. Good specimens are also found in Colorado. Nice specimens also occur in Alexander County, N. C.

Graphite—Occurs as small flakes in rock crystal; found in North Carolina.

Hematite—Tiny black platy crystals which often have a splendid luster occur in rock crystals in the hematite mines of Soudan, Minn.

Splendid rock crystals have been found at Cleator Moor, Cumberland, England, crystallized on massive, black hematite. Oftentimes the crystals not only enclose tiny black platy crystals of hematite but minute red "drops" of hematite as well.

Rock crystal enclosing hexagonal scales of Hematite occur at King's Mills, Iredell County, N. C.

Switzerland has produced many fine rock crystals often with interesting inclusions One such specimen examined by the writer encloses lustrous black, tiny, tabular crystals of hematite. The specimen is a broken mass from a large rock crystal, stained brown on one end. One face has been polished which shows up the inclusions very nicely. The inclusions are in the background and near the top and consist of about 18 hematites which are about ⅛ to ⅜ inches in diameter. The main crystal is 2x2 inches by 1 inch thick. Specimen is in the collection of Mr. H. Alban Anderson, Peekskill, N. Y.

See also aventurine quartz.

Hiddenite—In a narrow vein near White Plains, Alexander County, N. C., beautiful green hiddenite (Spodumene) has been found associated with beryl, orthoclase, pyrite and quartz. Hiddenite occurs in very small but transparent crystals which often are enclosed in rock crystals.

Hornblende — Occurs in slender, black, needle-like crystals resembling tourmaline in Alexander, Burke and Iredell Counties, N. C.

Liquid—Liquid inclusions in rock crystals are very common but they can be noted only if a bubble is present (see bubbles). The liquid is generally assumed to be water but it can also be of some other material. If a crystal containing liquid be heated, often slightly, the crystal will burst due to the expansion of the liquid. Herkimer County crystals are noted for liquid inclusions.

Very beautiful specimens have been found in White Plains, Alexander County, N. C.

Magnetite—At the Forest of Dean iron fine (magnetite) near Fort Montgomery, N. Y., slivers of magnetite have been found enclosed in rock crystal.

Manganese Oxide—Occurs near Hot Springs, Ark., and forming charming black phantoms.

Mica—See aventurine quartz; also muscovite.

Molybdenite—Perhaps the most noted locality for rock crystals enclosing molybdenite is Kings Gate, N. S. W., Australia; the molybdenite occurring as small grayish-black flakes and leaves in rock crystal.

Muscovite — Isolated, transparent muscovite crystals enclosed in rock crystal and forming handsome specimens have been found in Lincoln County, N. C.

Phantom—Sometimes a rock crystal is found which contains within it a faint outline of a crystal whose form is exactly similar to itself. This outline may be dark, light, or sometimes of almost the same shade as the main crystal so that detection of the outline may require keen eyesight. These outlines are known as phantoms. Phatoms may be rock crystals, when their color will almost duplicate the main crystal; smoky quartz, with dark brown outline; amethyst, purplish outline; chloritic, greenish outline.

From the appearance of its faces, the rock crystal is probably a twin. It contains a light phantom in the base the apex of which is about 1 inch high. A further development resulted in a primary crystal which endured so long all the faces on the terminal, with the exception of one, became frosted. A further development produced the secondary or enclosing crystal.

The frosted crystal is about 1½ inches in diameter and its apex projects to within 1 inch of the apex of the main crystal. The specimen is main crystal. The specimen is

about 2½x4 inches in size, was found in Serra Crystalina, Brazil, and is in the collection of Mr. H. Alban Anderson, Peekskill, N. Y.

Petroleum — Found at Guntersville, Alabama, enclosed in cavities in rock crystal.

Pyrophyllite—Known to occur in rock crystal from near Hot Springs, Ark.

Rock Crystal—See phantom.

Bates[1] reported a rock crystal from Herkimer County, N. Y., which contained a "dry" cavity in which was bitumin and a small perfect crystal of quartz.

One of the most interesting inclusions examined by the writer is rock crystal in rock crystal. The specimen comes from Brazil. The main crystal is 2¼ inches long and about 1 inch in diameter; the inclusion is 1¼ inches long and ⅝ of an inch in diameter. The inclusion penetrates the main crystal near the base at an angle of about 70 degrees so that it is almost vertical; the tip of its enclosed termination is stained red by hematite. The main crystal actually encloses two minerals, hematite and rock crystal.

The main rock crystal has no terminations and three of its faces have been polished in order to show the inclusions. Specimen is in the collection of Mr. H. Alban Anderson, Peekskill, N. Y.

Rutile—These are very common and occur as long, needle-like, dark-brownish crystals in quartz. Such specimens are known as rutilated quartz or sagenite; as Venus hairstone, or by the French, "fleches d'amour" (love's arrows). They take an excellent polish and are much used in jewelry.

Rutilated quartz of exceptional beauty have been found in North Caroline chiefly in Alexander, Burke, Catawba, Iredell, Jackson and Randolph Counties; the rutile varying from brown, red, golden to black in color. Alexander County especially is noted for the mineral and perhaps its most noted locality is Stony Point. Some very fine rutilated quartz, well crystallized and transparent, were uncovered in the monazite mines near Shelby, Cleveland County, N. C.

Very fine rock crystals up to 5 inches in diameter, showing in their centers, slender, golden-red crystals of rutile, have been found in New Zealand. These formed handsome specimens.

Radiating tufts of brilliant, tiny, brownish-yellow needles of rutile in rock crystal, occur in Switzerland.

Good specimens of rock crystal enclosing brilliant, capillary needles of rutile, 2 inches or more in length, have been found in the Valle da Ribeira, Sao Paulo, Brazil.

Nice specimens of rutilated quartz also occur in Madagascar.

Sand—Small particles of sand, generally grayish, may be found enclosed in rock crystal. Generally the surface of such a crystal is encrusted with sand. Found near Hot Springs, Ark.

Sericite—A small rock crystal, ½ inch long, enclosing greenish scales of sericite, was found at the

Siderite—Said to occur in rock crystal from Switzerland.

Smoky Quartz—Common as black phantoms in rock crystals. Beautiful specimens have been found in Lincoln County, N. C.

Sphalerite—One small loose crystal, ¾ inch long and doubly terminated, inclosed in its very center tiny masses of dark brown sphalerite; from the old lead mine at Ellenville, N. Y. See Ellenville Quartz Crystals in this issue.

Some crystallized rock crystals from Nenthead, Cumberland, England, inclose so many tiny black sphalerite crystals as to give the quartz a smoky appearance.

Stibnite—In the Province of Kai, Japan, some very interesting rock crystals inclosing stibnite are found. One specimen examined, about 2 inches long and 1¼ inches in diameter, enclosed thin tabular grayish-black crystals of stibnite being almost at right angles to the length of the quartz crystal and occupying cavities as the rock crystal has been fractured where the cavities now exist. It may be that the crystal, when found, was much larger and that the cavities had extended to the surface; the

1Bates, A. C.—*"Quartz and Its Varieties."* THE MINERAL COLLECTOR, July, 1895, page 68.

crystal may have been cut down considerably as it is now polished on all sides (a favorite stunt of the Japanese). The stibnite may have penetrated the crystal by means of the cavities.

From a mine at Rye Patch, Nevada, many years ago, some very limpid rock crystals enclosing beautiful needles of stibnite running in all directions, were obtained.

Near Lovelock, Nevada, loose rock crystals enclosing needles of stibnite are found in pockets in sand and gravel. (See article in this issue by Frank Garaventa.

Tourmaline — Tourmaline may be present either in short stout crystals or in long, needle like crystals resembling hornblende or rutile. Black is the chief color for tourmaline so enclosed. Sometimes a tourmaline crystal may be so large that the rock crystal is nothing more than a shell around it and it looks dense black in color. A noted locality for tourmalinated quartz is near Butte, Jefferson County, Mont.

Slender, grayish-blue tourmaline crystals in rock crystal occur in Brazil.

Uralite—Occurs in slender, prismatic crystals, dark green in color, in the small rock crystals of the copper mines of Sulzer, Alaska.

Dana[2] lists the following minerals as inclusions in rock crystal but none of them as yet have been noted by the writer:

Calcite and other carbonates.
Chrysoberyl.
Corundum.
Cyanite.
Fluorite.
Garnet.
Gold.
Pyroxene.
Silver.
Topaz.
Zeolites.

2Dana—*System of Mineralogy*, 6th Edition, page 188.

THE REAL BEAUTY OF HERKIMER COUNTY QUARTZ CRYSTALS

By W. J. HOLLISTER

In my experience with collectors, I find that 99% of amateurs and about 75% of advanced, overlook the greater beauty of these crystals.

I have had people look over an assortment of two hundred or more sizes and exclaim, "Aren't they beauties!" Of course they are answered in the affirmative. But wait. I will show you some that are much more beautiful; and then I produce about a peck of large, nearly opaque, broken fragments, etc.

"What do you think of these?" Answer is "Trash."

Let us see if that is so. After picking up one of the unattractive crystals and handing it and a good magnifying glass to them I instruct them to hold the crystal toward the light (electric) in such a manner that a silvery sheen appears on one of the planes. "O. K., now focus the glass on the crystal What do you see?"

"Oh my! I see a lot of cubes, triangles, columns, etc., that seem to stand out in relief." One person stated that he saw a whole book on geometry. Then, "What about the smaller crystals you showed us? Are the figures on them also?"

"Yes they are, but I showed you the larger ones as their figures are more easily seen."

Right and left handed, twins inclusions, phantoms, bubbles, etc., are present in many of the Herkimer County crystals and this added beauty will create a greater zest in viewing your crystals and each one is a potential picture of nature's art.

ELLENVILLE QUARTZ CRYSTALS

By PETER ZODAC, Editor

Rocks and Minerals

A locality noted for fine specimens is the old abandoned lead mine at Ellenville, Ulster County, N. Y., and those for which the mine is especially famous are rock crystals. The crystals occur loose, often doubly terminated; on a matrix; and in groups of crystals. As single crystals, the mineral varies in size from tiny, limpid ones, to large, stout crystals 3 inches long and 2 inches in diameter; sometimes the large crystals are flattened or otherwise deformed. Tiny twin crystals have also been found; also fine buttressed crystals.

The large stout loose crystals invariably are coated by brown limonite stain; in fact it is a mark of identification for the locality and the staining seems to be in the depressions of the crystals. This also holds true for many of the large flattened crystals, which commonly are doubly terminated.

The crystallized specimens are especially beautiful and exceptionally so when found in large groups, many of them, too, being doubly terminated. Generally the groups appear cavernous and in the depressions very fine chalcopyrite crystals, and sometimes sphalerite crystals also, are imbedded. These large groups lined fissures that were often many feet in length, in the mine. As a rule, no matter how large a group may be, the crystals in any group are generally all of the same size; consequently this characteristic plus the cominbation of chalcopyrite with the rock crystals is so prevalent that it is really a waymark of the locality.

The mine at Ellenville has been shut down for many years and no longer are the very fine crystals available although now and then a nice loose crystal or a group of crystals are uncovered. Unfortunately the dumps have been almost entirely taken away and what are left are small and insignificant and the material available generally so poor in quality as to be useless for specimens. The writer was of the opinion that minerals at the locality were a thing of the past but on a recent trip to the mine, with Dr and Mrs. John R. Evers of North Tarrytown, N. Y., and with Mr. Egbert McElroy of Monroe, N Y., as guide, some very fine crystals were collected.

The lead mine, also known as a zinc mine, is easily reached and worth a visit. The starting point is the railroad station in Ellenville, a delightful little village of 3,200 souls, although in summer the population is greatly increased as Ellenville is a summer resort. Canal street is the first street south of the station. Go east on this street, across the railroad tracks, and turn left and then right as it winds. Broadhead street will be passed on the right and about 100 feet further a dirt road on the left leads off to the mine 300 feet away.

The mine consists of a small water-filled shaft at the very bottom of Shawangunk Mountain, a long ridge with a northeast-southwest trend, the shaft being on its western flank. A waterfilled adit, extends eastward into the ridge right at the shaft; two small prospect holes are 75 feet and 155 feet south of the shaft. Two hundred feet up the ridge and on line with the adit, is another prospect hole. The immediate rock around the shaft, adit and prospect holes is a very tough, glaciated, grayish quartzite which being bare for some distance is very conspicuous.

Around the shoft is a remnent of the former dump and in the loose material, especially in the clay bank to the left of the shaft, tiny, loose, limpid rock crystals are common. The crystals are especially plentiful in the small, miniature gullies formed by water (after rain storms), where they will be seen projecting out of the ground; the soil having been washed away from them.

Three hundred feet away from the shaft and on line with the adit, and 100 feet to the left, is the best collecting area at the locality. The dump is about 200 feet in diameter and though only a remnent of what was formerly here nevertheless some very fine crystals were found on our trip. The procedure is to dig in the soil, here and there, and examine carefully what may be uncovered. Unfortunately much of the material dug out is so coated with clay and soil that it must be washed with water; this results in discarding most of the material that may be carried home. In this dump is a small depression, about 5 feet in diameter, and perhaps 2 feet deep. The story is told that a native, some few years ago, desiring to obtain crystals, induced some boys to dig the hole for him, telling them that a cave was there and that it had been covered up. So the boys, with thoughts of exploring the cave, set to work with lots of enthusiasm only to find out later that a hoax had been played on them.

In the 2nd prospect hole at the base of the mountain, we found a number of crystals in small cavities in the quartzite It seemed an easy task to dig some of them out but we soon changed our minds. In order to get at the crystals we had to dig into the cavities and OH! what a job that was Though we had chisels and sledge hammers we could make practically no impression on the tough quartzite. We hammered and pounded and then we hammered some more and still the rock would not give. It was a hot day and the work very laborious; and to make matters worse the cavities were not only wet but full of light brownish clay. As we hammered the water and clay spattered all over us. Never in all the writer's collecting, did he work so hard, get so dirty, and go away with such poor material for his labors except with one exception as at this prospect hole. We did, however, get one nice crystal out of the cavity which was presented to Dr. Evers.

Mr. McElroy advised the writer that during the World War the mine was reopened for a few weeks but had to be abandoned as the vein was pinched out. Some material was excavated which contained beautiful quartz crystals. It is said that the watchman collected all the quartz crystals and sold them; selling as much as $80 worth in some weeks.

The finest crystal the writer ever obtained at the locality, was found by him July 16, 1931, when he visited the mine for the first time in the company of Mr. Fred Schmeltz of New York City. At the small proving hole 200 feet above the adit, a beautiful little butterfly twin was found.

On August 23, 1936, a number of small specimens of crystallized quartz were found by the writer which contained tiny plates and tiny crystals of dark brown sphalerite as inclusions. In some cases crystallized sphalerite penetrated the quartz and in the same specimens tiny crystals of sphalerite were entirely enclosed by the quartz.

It may not be amiss to say that if rock crystals are desired the locality should be visited right after a heavy rainstorm, as rains wash crystals out of the soil.

Should one desire to see an assortment of Ellenville crystals, the writer suggests visiting Mr. McElroy at his home in Monroe instead of the locality, or even a museum. Here the visitor will see such an assortment of these beautiful specimens as to take his breath away. So plentiful are the crystals in large slabs, that he has actually built them in the foundation, walls and fireplace of his home; in fact his house seems to be built almost entirely of Ellenville quartz! And he has some very fine specimens in his collection—many loose doubly terminated, small groups and slabs containing many groups. The finest specimen is a large group about 24x18x8 inches in size; the best the writer has seen anywhere from the locality.

In addition to rock crystals, the mine is also noted for aurichalcite, anglesite, brookite, chalcopyrite, cocovellite, chlorite, galena, pyrite and sphalerite.

SOME OLD QUARTZ LOCALITIES IN RHODE ISLAND

By ARTHUR L. FLAGG, Mining Engineer

Phoenix, Ariz.

Many readers of Rocks and Minerals may be interested in a few random notes concerning localities in Rhode Island which have furnished both interesting and beautiful specimens of quartz in one form or another. Since it has been more than thirty years since I visited any of these localities some of my descriptions may not be absolutely accurate. Again, there have been so many changes, particularly new road location, new building and the like that I am sure it would puzzle me some to go directly to a number of the old localities which I knew so well at one time.

Beginning in the northwest corner of the State, in Burrillville, the old Steere farm which was a typical abandoned New England farm in 1900, was a place where one could be sure of finding amethyst. The loose crystals occurred in the decomposed residue of either a pegmatite dike or a quartz vein, which was in a coarse grained granite, also badly decomposed near the surface. This weathered condition simplified the search by making the digging easy though the crystals were usually enclosed in a stiff clay The choice spot was a little hump in the lane leading from the county road to the farmhouse. Practically every crystal found was of good shape, in fact the crystals or group of crystals, were rather remarkable for their symmetry. The color was a different matter. Most of the crystals were of a dirty yellow, often cloudy too, though they might be tinged. faintly, with a faded amethyst color. Finally, I managed to secure one crystal which well repaid me for all the effort I had made. It is more than an inch in diameter, over two inches long (the bottom third is rather milky) and has a perfect termination, clear (phantom) and a very rich color.

To the northeast and just over the line into Massachusetts, along the Mendon road which leaves the Woonsocket to Blackstone road near the site of the old covered bridge and the old High School, not far from this junction, on the right in a steep bank, close to the road, was a small excavation from which one might get occasionally a small, clear quartz crystal enclosing rich, brown and slender needles of rutile. The rest of the quartz, more or less opaque had, on natural fractures, a delicate lattice-work of brilliant rutile crystals. Passing by three years ago I noted that the bank had been much cut down and the original excavation entirely wiped out.

In quartz veinlets about the old rock quarry in the Fairmount district of Woonsocket, a quarry known in those days as the "Old Maids' Quarry," could be found, now and then, a few crystals of quartz, moderately clear, with some sort of inclusion—hornblend, chlorite, etc. The same quarry yielded some of the less common minerals, but always in almost microscopic quantities.

East and southwest of Woonsocket, in the town of Cumberland, which embraced Iron Mine Hill, Beacon Pole Hill, Diamond Hill and Sneech Pond, there was a rather wide range of material to be found. Some of the most attractive specimens have come from there. In Dana's "Catalog of American Localities" it is reported that crocidolite may be found near Beacon Pole Hill. I never found the spot which produces the crocidolite but on the west slope I did find a very beautiful aquamarine crystal, about a quarter of an inch in diameter, by nearly an inch and a half in length. This was in a glacial boulder of coarsely crystallized granite. A similar crystal of beryl, though not so clear and a bit larger, came from the old Joe Cook farm to the west

Diamond Hill proper has furnished a wealth of crystals, in slabs, good, bad, and indifferent. Most of the

crystals are small. It did not require much effort to find pleasing jasper, red and white predominating, but frequently a small specimen showing a somewhat faded blue. The old Hill should still be a good place for the amateur lapidist. Which reminds me that my polished jaspers from there were ground down with emery on an old stove lid and much "elbow grease."

By far the most interesting and most beautiful material from this general section are the specimens of clear quartz containing either rich green actinolite, Thetis Hair Stone, or the black needles of hornblende, such as are pictured on page 216 in English's **Getting Acquainted With Minerals.** The actinolite in quartz came from the east shore of Sneech Pond, (there is an old copper mine there too, if you can find it) while the hornblende in quartz came from a quarry near by.

Westward, half way across the state, which is really but a short distance, are the old lime quarries, Harris, Middle and Dexter. I believe these are all idle now and filled with water. The Dexter quarry afforded a wonderful array of quartz crystals. Brilliant, water-clear, sometimes tinted a delicate yellow, frequently doubly terminated, and often assuming a grotesque form or odd grouping, these crystals were abundant but it required a knowledge of the nature of the enclosing rock, which could be gained only by experience, to get them out without damage. A symmetrical crystal with scintillating inclusions of nacrite might be the prize for a day's labor. The grand prize for a season's effort would be a specimen on which might be perched one or more brilliant microscopic crystals of octahedrite. Combinations of quartz and calcide were often found but these were rarely as interesting as either variety of crystal alone.

In the town of Cranston, quite hemmed in by dwelling houses, there used to be an old graphite mine, which was worked now and then. The graphite, which was rather poor in quality, was used principally for foundry facings. From this mine came a fibrous quartz, silky, usually white, but not infrequently tinted a pale green and very rarely a delicate red. This structure was developed, probably, when the sediments of the Narragansett Basin were crumpled and folded. This material in some ways resembles the pseudomorphous quartz, crocidolite, but the fibers are less compactly held together, and the material in general more brittle.

Further south, in the central part of the State, many interesting forms of quartz have been found in glacial boulders. The coarse grained granite boulders are the most likely hiding place for plain crystals or those with rare "freak" inclusions. Very often these boulders contain other minerals of beauty and interest to the collector, for example the kyanite near Foster.

Perhaps the changes which have obscured the profitable collecting localities of a quarter of a century ago have opened up new sources of similar or even better material. However that may be, the old localities have yielded their share of mineralogical treasure, much of which found resting place in the local collections. Some of it went far in exchange for minerals of other localities. All of it brought thrills to the collector and joy to many who appreciate the mystery and beauty in minerals.

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STIBNITE IN QUARTZ FROM NEVADA

By FRANK GARAVENTA

The average person driving west through Nevada would rarely expect to find priceless gems in a rough state, rare ores or interesting mineral specimens in the sagebrush flats of the Desert State. But all these do occur and in large quantities.

Near Lovelock, in Pershing County, in the gray-green sage-covered hills and valleys, are large deposits of gold, silver, copper, lead and antimony ores; many occurrences of interesting minerals of which some are semi-precious gems.

Among the recent finds made by the writer in this district, the most interesting was an unusual occurrence of acicular stibnite crystals enclosed in rock crystal. The quartz crystals occur in sporadic pockets, loose in sand and gravel, and at a depth varying from two to four feet, between a hanging wall of meta-andesite and a footwall of Teriary andesite.

The crystals when found are coated with iron oxide which gives them an ugly, rough appearance but once cleaned off with soap, water and a stiff brush they often turn out very beautifully. The grayish-blue needles of stibnite run in all directions but seem to be concentrated in the centers of the crystals then elsewhere. Some of the crystals are as long as four inches though most of them are much shorter.

The crystals are not easily found as I have often dug a whole day without uncovering even one good specimen but small specimens are fairly common. The smaller crystals often enclose reticulated stibnite and in other shapes as if the stibnites were sailing away in a quartz sea.

In this vicinity is found chrysoberyl in pegmatite with related gems, chalcedony in grape-like form, wonder stones which are similar to the most beautiful agates found anywhere, frosted stones, agates, agatized wood, orthoclase crystals, and other interesting minerals.

J. A. GRENZIG, 299 Adams St., Brooklyn, N. Y

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DIGGING ROCK CRYSTALS NEAR NAPANOCH, N. Y.

By PETER ZODAC, Editor

Rocks and Minerals

One and a half miles north of Ellenville, Ulster County, N. Y., and alongside of an old dirt road east of the railroad and Rondout River, both of which connect Ellenville and Napanoch, is an old abandoned quartzite quarry The quarry, approximately 400 feet long, 150 feet wide and 100 feet high at its face, is at the base of Shawangunk Mountain, a long ridge extending for many miles with a northeast-southwest trend. The quarry is said to have shut down about 1920.

Pyrite is a very conspicuous mineral in the quarry and especially at its extreme southern end where it forms thin veins in the dark gray quartzite. Some nice specimens of pyrite can be collected.

But a better and more desirable mineral is present, rock crystal. This occurs as doubly terminated loose crystals of excellent quality in a dark gray sticky clay—sticky because it is wet.

A visit was paid the locality August 16th, 1936, with Dr. and Mrs. John R. Evers of North Tarrytown, N. Y., and with Mr. Egbert McElroy of Monroe, N. Y., as guide.

During the search for some nice pyrite, Mr. McElroy climbed to a small ledge, perhaps 25 feet above the floor of the quarry, and in digging out the mineral uncovered a clay pocket. Whether a rock crystal projected out or not, the writer never ascertained how they were discovered, but Mr McElroy soon began throwing down rock crystals. The crystals were coated with clay but fortunately a small stream from a nearby spring furnished us water in which we washed them. Many of the crystals were of such good quality and Mr. McElroy kept throwing down so many that the writer could stand it no longer; he had to go up and see for himself.

The pocket turned ou to be about a foot square tapering inwardly. It had no physical attraction nor appeal; just a small mass of dark clay that seemed to fill a small depression in the rock. No crystals were visible and the writer had to feel in the clay, which was sticky as had been said. Soon something hard was encountered, but, while he knew from the feel it was a crystal, the crystals and his hands were so coated with the sticky clay there was nothing to do but throw them down to the Doctor for washing. In order to prevent damage to the crystals, we wrapped them in clay balls when dropping them; thus making "mud pies" with crystals as the filling. About the largest crystals uncovered were two inches long, some slightly flattened, a few smoky.

It was quite thrilling, digging into the clay and bringing out crystals. Now and then the clay would fall off so that a crystal could be seen almost entirely. In this way Mr. McElroy uncovered some excellent ones. As we dug deeper the clay became harder and dryer and it was more difficult to dig crystals out. Added to this, our perch on the ledge was not a comfortable one. The ledge sloping and offering only a narrow foothold so that we were greatly cromped. Furthermore, the pocket was small and we could not work together but in rotation. We were also in somewhat of a predicament when we needed a knife or a handkerchief as our hands were too coated with clay to stick them in our pockets. All in all it was quite an experience and we enjoyed it thoroughly. The wonder of it was—how could such beautiful crystals occur in the dirty clay! Nature is strange in many ways and who can understand her?

THE AMATEUR LAPIDARY

Conducted by J. H. HOWARD*
504 Crescent Ave., Greeneville, S. C.

Amateur and professional lapidaries are cordially invited to submit contributions and so make this department of interest to all.

*Author of—*The Working of Semi-Precious Stones*, and *Handbook for the Amateur Lapidary*.

RELATIVE HARDNESS OF MINERALS

By ARTHUR KNAPP

The following is an Extract from

MINERAL INDUSTRY 1935, McGraw-Hill Book Co.

Hardness of Diamonds—It has long been realized that the old Mohs scale of hardness, in which corundum was 9 and diamond 10, was entirely out of proportion to the rest of the scale, as the actual hardness difference between these two substances was greater than all of the rest of the scale from 1 to 9. C. E. Wooddell has studied various electric furnace products in comparison with quartz, corundum and diamond, using an abrasion method, and has prepared the following table of results, giving the comparative hardness of several different varieties of diamond.

Hardness of Diamonds and Other Substances

	Scale Corundum—9 Diamond—10	Scale Quartz—7 Corundum—9
South African brown bort	10.00	42.4
South American ballas	9.99	42.0
Belgian Congo Yellow (cubic crystals)	9.96	41.0
Belgian Congo Clear White (cubic crystals)	9.95	40.7
Belgian Congo Gray Opaque (cubic crystals)	9.89	38.7
South American carbonados	9.82	36.4
Boron carbide	9.32	19.7
Black silicon carbide	9.15	14.0
Green silicon carbide	9.13	13.4
Tungsten carbide (13 per cent cobalt)	9.09	12.0
Fused alumina (3.14 per cent Ti02)	9.06	11.0
Fused alumina A	9.03	10.0
African crystal corundum	9.00	9.0
Rock crystal quartz	8.94	7.0

While the above does not check with ideas we have held to, it is of distinct interest to every amateur lapidary and is due some study. It is the first time we have seen a table listing relative hardness of the synthetic materials with which we cut most gems.

—ARTHUR KNAPP.

ROCK CRYSTAL GLOSSARY

By PETER ZODAC, Editor
Rocks and Minerals

Introduction

It is to be regretted that rock crystal, having only one color and composition, can assume so many confusing names. However, due to its brilliance, hardness and attractiveness, it can be cut into nice gems but because of its widespread occurrence, rock crystal cannot command the price of the more expensive stones. Therefore, in order to enhance its value, its masquerades under a more precious sounding name and from far flung localities. The writer knows of one instance where faceted rock crystals were advertised in a jewelry store as Borneo "diamonds"; a few months later the same material was advertised as Sumatra "diamonds." For all he knows the next time they may be advertised as Java "diamonds." If the source be known, all this material may have come, probably, from Brazil. And so commercialism leads a harmless quartz crystal further into the wilderness.

If all the assumed names given rock crystal by "jewelrs" were known and printed, this list, probably would be many times larger than it is.

Acknowledgments

In the compilation of this glossary, the writer has drawn freely from Gilbert Hart's **Compilation of Gem Names.** Other sources were Kraus and Hunt's **Mineralogy,** and Dana's **System of Mineralogy.**

Alaska Diamond—Rock crystal from Alaska.

Alencon Diamond—Rock crystal from Alencon, France.

Arkansas Diamond—Rock crystal from Arkansas; also real diamond from Arkansas.

Babel Quartz—A variety of rock crystal built up of tiny hexagonal layers, heaped one on top the other and gradually diminishing in size as they approach the summit. It received its name from its fanciful resemblance to the successive tiers of the Tower of Babel of biblical history.

Baffa Diamond—Rock crystal from Baffa, Scotland.

Bent Crystal—As its name implies, it is a crystal that has been bent by nature. Sometimes such crystals have been fractured or broken and the injured parts recemented by quartz or other material.

Bohemian Diamond — Rock crystal from Bohemia.

Borneo Diamond—Rock crystal

Brazilian Diamond — Rock crystals from Brazil; also real diamond from Brazil.

Brazilian Pebble—Rock crystal from Brazil (optical quality).

Briancon Diamond — Rock crystal from southeastern France which is cut in the city of Briancon.

Bristol Diamond—Rock crystal from Cornwall, England.

Bristol Stone — Rock crystal from Cornwall, England.

Butterfly Twins—Two flattened contact twins resembling in appearance the spread wings of a butterfly.

Buttressed Quartz—A quartz crystal with a number of small quartz crystals attached to its base in a way as to resemble a buttress in masonry construction.

Buxtom Diamond—Rock crystal.

Cape May Diamond — Rock crystal from Cape May, N. J.

Capped Quartz—Two quarts crystals growing in parallel layers, one crystal over the termination of the other, and separated by a fine layer of clay, mica or some other mineral which prevents the two crystals from adhering to each other. Generally a small crystal caps a large one.

Cavernous Quartz—When a quartz crystal contains deep cavities resembling slits, that are parallel to its faces, it is said to be cavernous. It is believed that the slits are due to the interference of impurities during the formation of the crystals.

Contact Twins—The simplest form of twins. Two crystals united to each other along one common edge — side by side. See twin crystals.

Coradgee Stone—Rock crystal

Cornish Diamond—Rock crystal from Cornwall, England.

Cross Twins—Two penetrating twins so arranged as to resemble a cross.

Cruciform Twins — Same as cross twins.

Crystal—Colorless, transparent quartz In mineralogy, any mineral with a definite internal molecular structure whose exterior is bounded by natural plane surfaces.

Crystalline—When a mineral has a crystal structure but without definite geometrical form, it is said to be crystalline.

Crystallized—A group of crystals generally on matrix.

Cupid's Darts—Quartz crystals with needle-like inclusions of goethite.

Cupped Crystal—When in place of a termination there is a hollow (sometimes said to be a sunken pyramid), the crystal appears to be cup shaped and is said to be a cupped crystal or cupped quartz.

Cupped Quartz—Same as cupped crystal.

Dauphine Diamond — Rock crystal from Dauphine, France.

Detached Crystal—A loose crystal.

"Diamond"—Rock crystal that is perfectly clear and flawless with the brilliant faceting of a precious stone. Name is often used as a locality suffix.

Distorted Crystal—A crystal whose faces have been pushed out of shape

Doubly Terminated Crystal—A crystal whose two terminations are present.

Courtesy Ward's Natural Science Est.

QUARTZ, VAR. ROCK CRYSTAL

(Crystallized)

NEAR HOT SPRINGS, ARKANSAS

Doubly Terminated Quartz—A quartz crystal whose two terminations are present.

Dragonite—Water worn rock crystal pebble with a brilliant luster.

Drusy Quartz—Quartz occurring as a crust of tiny, closely crowded crystals, resembling sandpaper in appearance.

Etched Crystal—Corroded crystal.

False Diamond—Rock crystal that is perfectly clear and flawless with the brilliant luster of a precious gem.

Flattened Crystal—Crystals with a more or less rounded outline are often found in a misshapen form, very thin and elongated, as if some prehistoric monster had stepped on them when they were forming. Some flattened crystals have been formed in thin crevices of tough rocks where it was not possible for them to attain their natural form. Hence, under the circumstances, they did the best they could do.

Flesches d'Armour—Sagenite.

Fleurus Diamond—Rock crystal

Frozen Crystal—A crystal imbedded almost wholly in some very tough rock or mineral so that it is very difficult or almost impossible to extricate it in good condition.

Gemmy Crystal—A crystal suitable for cutting as a gem.

Ghost Quartz—Another name for a quartz phantom.

Hairstone—Quartz with inclusions of some hair-like crystals, threads or fibers. See sagenite.

Herkimer County Diamond — Rock crystal from Herkimer County, N. Y.

Herkimer Diamond—Same as Herkimer County Diamond.

Horatio Diamond—Rock crystal from Arkansas.

Hot Springs Diamond—Rock crystal from Hot Springs, Arkansas.

Hyacinth of Compostella—Rock crystal with red hematite inclusions.

Inclusions—Foreign mineral or substance enclosed within a crystal.

Interpenetration Twins — Same as penetration twins.

Iridescent Quartz—Quartz filled with fine cracks containing air films which reflect the colors of the rainbow

Iris—Same as iridescent quartz.

Irish Diamond—Rock crystal from Ireland.

Isle of Wight Diamond—A fine transparent rock crystal from the Isle of Wight, England.

Krystallos—The Greek name for rock crystal.

Lake George Diamond—Rock crystal from Diamond Island in Lake George, Warren County, N. Y.

Limpid Quartz—Pellucid quartz crystal.

Loose Crystal—Not attached, fastened or imbedded in or with anything.

Love Arrows—Sagenite.

Marmorosch Diamond—Rock crystal from Marmoros Comitat, Hungary.

Matrix—A crystal is said to be in or on matrix when it is imbedded in or attached to a rock or a mineral regardless of what the rock or the mineral may be.

Melted Crystals—Crystals with edges considerably rounded or eroded as if they had been melted.

Mexican Diamond—Rock crystal from Mexico.

Middleville Diamond—Rock crystal from Middleville, N. Y.

Modified Crystal—A crystal with a large number of faces.

Montana Diamond—Rock crystal.

Mora Diamond—Rock crystal.

Mountain Crystal—Rock crystal.

Needle Stone—Sagenite.

Negative Crystals—Cavities in a quartz crystal which have the exact form as the quartz itself are called negative crystals.

Occidental Diamond—A lapidary's term for limpid quartz when cut and polished in contradistinction to the oriental or true diamond.

Onegite—Quartz with inclusions of hair-like crystals of goethite. First found on an island in Lake Onega, Russia.

Optical Quartz—Best grade of rock crystal for commercial purposes.

Paphos Diamond—Rock crystal.

Parallel Growth—Two or more crystals with correspondin~ faces parallel. They are generally attached to one large crystal.

Pebble—A small roundish stone with smooth surface due to the action of water. Many gems occur in the form of pebbles; rock crystal is often found in this form.

Pebble Crystal—A crystal found in the form of a pebble.

Pecos Diamond—Rock crystal from the Pecos River district, Texas.

Penetrating Crystals—Two or more

crystals which penetrate one another.

Penetration Twins—When two twin crystals penetrate each other they are said to be penetration twins. Compare with contact twins.

Phantom Crystal—A crystal in which an earlier stage of crystallization is marked in some way in its interior; generally with a faint outline whose form is exactly similar to that of the crystal.

Points—A common name for terminated quartz crystals used by many who are unfamiliar with crystals.

Prism—The six planes that run parallel with each other and which enclose the main mass of a quartz crystal form its prism.

Pseudodiamond—Rock crystal.

Pyramid — The triangular planes which, meeting in a point and terminate a quartz crystal, form its pyramid.

Quartz Diamond—Clear and flawless rock crystal with the brilliant faceting of a precious gem.

Quartz Phantom—When a phantom within a quartz crystal is quartz.

Quartzoid—Quartz crystal having the form of two six-sided pyramids base to base;thus having no prism.

Quebec Diamond—Limpid rock crystal from Cape Diamond, near Quebec, Canada, occuring in argillite.

Quartz crystal—In its common form consists of a six-sided prism terminated at one end by a six-sided pyramid. The opposite end may show a rough, uneven surface due to the crystal having been broken off its matrix. Sometimes the crystal may show two six-sided pyramids, one at each end, and is then said to be doubly terminated. Very fine parallel lines, termed striations, and which run at right angles to the length of the crystal, always are present on all faces of the prism. If striations are absent, the face or faces have been polished or possibly broken. Striations never occur on the pyramids.

Rainbow Quartz—Iridescent quartz.

Rain Stone—Water worn pebbles of rock crystal.

Courtesy Ward's Natural Science Est.

PHANTOM QUARTZ

PROVINCE OF GOYAZ, BRAZIL

Rhinestone—Rock crystal cut as a brilliant to imitate a diamond and set in cheap jewelry. Glass is also used for the same purpose.

Rock Crystal—Clear quartz crystal often limpid and flawless.

Rock Quartz—Rock crystal.

Sagenite—Quartz crystal with inclusions of hair-like or needle-like crystals or fibers or some mineral, generally rutile.

Sagenitic Quartz—See sagenite.

Sandstone Diamonds—Rock crystal from Herkimer County, N. Y.

Schaumberg Diamond—Rock crystal from Schaumberg, Hesse, Germany.

Scepter Quartz—Generally a slender crystal with one termination enlarged and thus resembles roughly a scepter.

Scotch Diamond—Rock crystal from Scotland.

Secondary Growth—When a crystal, generally small in size, has been formed on or attached to a main crystal, the small crystal is said to be of secondary growth; that is, it has been formed long after the main crystal was. Secondary growth crystals may be attached to any face of the main crystal.

Courtesy Ward's Natural Science Est.

QUARTZ (TWIN CRYSTALS)

(Contact Twins)

KAI PROVINCE, JAPAN

Skeletal Crystal—A crystal whose faces are incompletely developed, often having a cavernous appearance.
Slim Jims—Name given by natives of Arkansas to extremely slender rock crystals of their state.
Striations—Very fine parallel lines marking the surfaces of many crystal faces. In quartz crystals, the striations are only on the prisms and run at right angles to the length of the crystals. If the striations are not present on a quartz crystal then they have been obliterated.
Sumatra Diamond—Rock crystal.
Terminated Crystal—When one termination of a crystal is present it is said to be terminated; if both are present, it is doubly terminated.
Terminated Quartz—See terminated crystal.
Thetis Hairstone—Rock crystal with inclusions of hair-like crystals of green actinolite.
Transparent Crystal—When objects can be distinctly seen through a crystal, the crystal is said to be transparent.
Trenton Diamond—Rock crystal from Herkimer County, N. Y.
Twin Crystals—When two crystals are attached or penetrate each other in such a way that one or more parts of one crystal, regularly arranged, are in reverse position with reference to the same parts of the other crystal, the two are said to be twin crystals.
Twisted Crystal—A crystal that has been warped, turned or twisted.
Unripe Diamond—In India, the natives believe rock crystal is the mother or external husk of the real diamond; hence the real gem was called the ripe diamond while rock crystal was called the unripe diamond.
Vallum Diamond—Rock crystal from the Tanjore district, Madras Presidency, India.
Venus Hairstone—Sagenite.
Wicklow Diamond—Rock crystal from Wicklow, Ireland.
White Sapphire—Corundum; also rock crystal.
White Topaz—Topaz; also rock crystal.
Xl—Abbreviation for crystal.
Xls—Abbreviation for crystals.
Xline—Abbreviation for crystalline.
Xled—Abbreviation for crystallized.

GILBERT HART -- *Geologist*

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